भारतीय मानक
Indian Standard

IS 17346 : 2020

काँच के इन्सुलेटिंग इकाई — विशिष्टि

Insulating Glazing Unit — Specification

ICS 81.040.20

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March 2020 **Price Group 7**

Glass, Glassware and Laboratoryware Sectional Committee, CHD 10

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Glass, Glassware and Laboratoryware Sectional Committee had been approved by the Chemical Division Council.

Insulating glazing units (IGU) are pre-assembled units consisting of panes of glass that are sealed at the edges and separated by dehydratedspace(s). The insulating capability of IGUs reduces the load on air conditioning and aid in energy conservation. A few applications of insulating glazing units include windows, window walls, picture windows, sliding doors, patio doors, railway coaches etc.

In preparation of this standard, assistance has been derived from the following publications:

ISO 20492-1 : 2008	Glass in buildings — Insulating glass — Part 1: Durability of edge seals by climate tests
ISO 20492-3 : 2010	Glass in buildings — Insulating glass — Part 3: Gas concentration and gas leakage
ISO 20492-4 : 2010	Glass in buildings — Insulating glass — Part 4: Methods of test for the physical attributes of edge seals
BS EN 1279-1 : 2004	Glass in building — Insulating glass units — Part 1: Generalities, dimensional tolerances and rules for the system description

The list of experts who made significant contribution to the formulation of this standard is given in Annex N.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’.The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

INSULATING GLAZING UNIT — SPECIFICATION

1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for Insulating Glazing Units (IGU) meant for use in architectural buildings, railway coaches and other applications like visicoolers, humidity chambers, incubators etc.

NOTE — Units where the nature is only artistic are not part of this standard.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No	*Title*
1382 : 1981	Glossary of terms relating to glass and glassware (*first revision*)
2553 (Part 1) : 2018	Safety glass — Specification: Part 1 Architectural, building and general uses (*fourth revision*)
4905 : 2015	Random sampling and randomization procedures (*first revision*)
14900 : 2018	Transparent float glass — Specification (*first revision*)
17004 : 2018	Testing methods for processed glass

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1382, IS 2553 (Part 1), IS 14900 and IS 17004, in addition to the following shall apply.

3.1 Bite size —the distance from the primary sealant bottom sight line to the edge of the IGU.

3.2 Cavity (Cavities) —The space(s) between the parallel panes of an IGU.

3.3 Cohesive Failure — The sealant tears within itself, but remains fully bonded to the substrate, when an external pulling force is applied.

3.4 Desiccant — A substance which is able to lower the partial pressure of water vapour inside the IGU.

3.5 Edge Seal —The processed edge of an insulating glazing unit, designed to ensure that moisture and gas transmissions between the inside and outside of the unit are restricted, designed with a certain mechanical strength, and designed with a certain physical and chemical stability.

3.6 External Condensation —Condensation appearing on the glass panes of an insulating glass unit either on the room side surface or on the external surface.

3.7 Gas-filled Insulating Glazing Units — An insulating glazing unit, the cavity of which contains gas(es) in addition to air, usually for improving thermal and/or sound insulation.

3.8 Insulating Glazing Unit (IGU) — An assembly consisting of at least two parallel panes of glass, separated by one or more spacers, hermetically sealed along the periphery, mechanically stable and durable.

3.9 Moisture Penetration Index — A measure of the drying capacity exhausted after standardized ageing conditions.

3.10 Standard Room Conditions — Ambient temperature of 27 ± 2°C and a relative humidity of 65 ± 5 percent.

3.11 Sealant — Sealing material that, after application, has sufficient mechanical properties of cohesion and of adhesion to glass and/or spacer for use in edge seals.

3.12 Spacer — A component used to separate the panes and control the width of the gap at the edge of the unit.

3.13 System — A range of insulating glazing units with a common edge seal profile, edge seal materials and edge seal components as described in the system description. The range shall have a similar edge seal performance, for example, moisture penetration index, gas loss rate.

3.14 System Description —Description of components and the edge seal of the insulating glazing unit in terms relevant to identification and in terms relevant to edge seal performance, for example, moisture penetration index, gas loss rate.

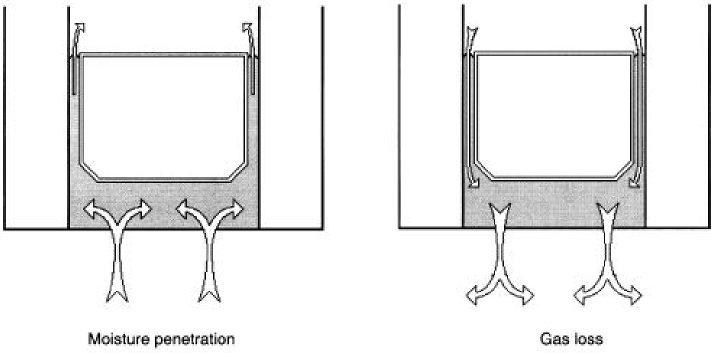


FIG. 1 MOISTURE PENETRATION AND GAS LOSS

4 CONSTRUCTION

Insulating glazing units are two or more panels of glass spaced apart and hermetically sealed to form a single unit with air or gas filled space between the panels. Typically, the spacer is made of aluminium that is either mill-finished or painted/anodized in different colours or finishes. Desiccants are filled inside the spacer framework to prevent condensation inside the unit. The primary sealant acts as a barrier to moisture and vapour penetration. The secondary sealant provides structural integrity to the unit.

5 REQUIREMENTS

5.1 Physical Requirements

Individual panes of the IGU shall conform to the relevant product standards, or as agreed to between the purchaser and the manufacturerin the absence of the relevant Indian Standard.

The allowable joints in case of bendable spacers used in construction of IGU shall be between 1 and 4.

5.1.1 *Dimensions and Squareness*

5.1.1.1 *Dimensions*

The horizontal edge of the IGU shall be designated as width (W) and the vertical edge shall be designated as length (L) or height (H). The tolerance on nominal dimensions shall be as prescribed in Table 1.

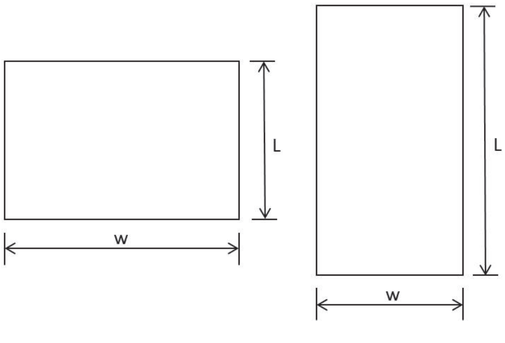


FIG. 2 EXAMPLES OF WIDTH AND LENGTH/HEIGHT WITH RESPECT TO PANE SHAPE

NOTE — For IGUs containing patterned glass panes, the direction of the pattern should be specified relative to one of the dimensions.

Table 1 Tolerances on Width W and Length L/H

(*Clauses* 5.1.1.1 and 5.1.1.2)

Nominal Dimension of Side	Tolerance, v	
	Nominal Glass Thickness t ≤ 8	Nominal Glass Thickness t > 8
≤ 2 000	± 2.5	± 3
>2 000 and ≤ 3 000	± 3	± 4
> 3 000	± 4	± 5

All dimensions are in mm

NOTE — Nominal thickness corresponds to the thickness of thickest pane in the insulating glazing unit.

5.1.1.2 *Squareness*

The nominal dimensions, that is, width and length/height shall be as agreed to between the purchaser and the supplier. However, the finished pane shall not be larger than a prescribed rectangle of dimensions (W+v, L+v), or smaller than a prescribed rectangle of dimensions (W-v, L-v), where v is the maximum tolerance on nominal dimensions (*see* Table 1). The corresponding sides of the prescribed rectangles shall be parallel to each other and the rectangles shall have a common centre (*see* Fig. 3).

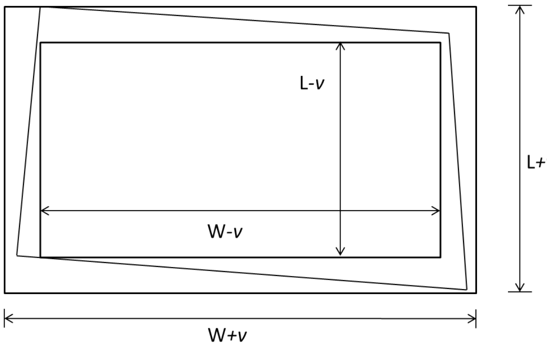


FIG. 3 TOLERANCE LIMITS FOR DIMENSIONS OF RECTANGULAR PANES

5.1.2 *Thickness Tolerance along the Periphery of the Unit*

The actual thickness of IGU shall be measured between the outside glass surfaces of the unit, at each corner and at the approximate centre points of the edges, as per the method prescribed in **5.1** of IS 17004. The values shall be measured to the nearest 0.1 mm. The measured thicknesses shall not vary from the nominal system thickness of the IGU by more than the tolerances prescribed in Table 2.

Table 2 Thickness Tolerance of IGU

(*Clause* 5.1.2)

Nominal Thickness	Tolerance
≤ 24 mm	± 1.0 mm
> 24 mm	± 2.0 mm

5.1.3 *Displacement/Mismatch*

For all thicknesses and for all range of dimensions, displacement/mismatch tolerance between the two glass panes shall be ± 2.0 mm. A suitable calibrated equipment, for example, a caliper, shall be used to measure displacement/mismatch.

NOTE — Glass Edge Finish**:** Edge finish may be as agreed to between the manufacturer and the purchaser. Since insulating glazing units are mostly used in applications where edges are either concealed or sealed with secondary sealant, it is generally not required to have glasses with polished or ground edges. Arrising of the edges is generally enough in most cases.

5.1.4 *Sealant Protrusion*

For all thicknesses and for all range of dimensions, the allowable primary sealant protrusion shall be ± 2.0 mm. A suitable calibrated equipment, for example, a caliper, shall be used to measure sealant protrusion.

5.1.5 *Bite Size*

The minimum bite size, when measured using a Vernier caliper/scale, shall be 6mm.

NOTE — The purchaser shall clearly prescribe the optimum bite size calculated considering the application, installation technique, glass thickness, panel size and wind and other subjected loads. The recommended seal dimensions are shown in Fig. 4.

5.2 Performance Requirements

5.2.1 *Dew/Frost Point Measurement*

The frost/dew points of all cavities shall be -40°C or lower, when tested as per **7.4.1** and **7.4.2** of IS 17004.

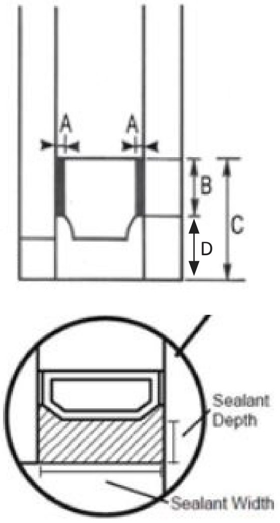
5.2.2 *Climate Test* (*Optional*)

When tested as per **7.4** of IS 17004, insulating glazing units shall satisfy the following requirements:

a) The average moisture penetration index over the five test specimen shall not exceed 0.20 (20 percent).
b) The average moisture penetration index shall be the average of the measurements of five individual units. However, any breakage of glass during test shall not be considered a failure and spare IGU shall be used for the test instead of the broken test specimen.
c) The highest measured moisture penetration index of any unit shall not exceed 0.25 (25 percent).

5.2.3 *Inert Gas Level Test* (*Optional*)

When the system description includes inert gas-filled insulating glazing units, the sample shall be tested for the gas level as per **7.5** of IS 17004. The fill of inert gas in the IGU shall not be less than 90 percent.



Key	
A	0.25 mm to 0.40 mm
B	4.78 mm to 6.00 mm
C	10.78 mm to 12 mm
D	6.00 mm

FIG. 4 RECOMMENDED SEAL DIMENSIONS

5.2.4 *Edge Strength* (*Type Test*)

Tensile load may be applied on the test specimen by means of an extensiometer or a Roman scale.

5.2.4.1 All edge seals shall have sufficient adhesive and cohesive strength to allow the extension of seals so that any rupture of the seal occurs outside the area 0AB of Fig. 5, when tested by means of an extensiometers prescribed in Annex A.

If, during the strength test of the glass-sealant-glass joint, as seen from the side view, loss of adhesion or cohesion extends through the whole depth of the sealant within the area 0AB of Fig. 5, then the sealant test specimen shall be deemed to be failed (*see* Fig. 6). The principle of light transmission through the defect can be applied to determine pass or failure.

Any breakage of glass during test shall not be considered a failure and spare test specimen shall be used for the test instead of the broken test specimen.

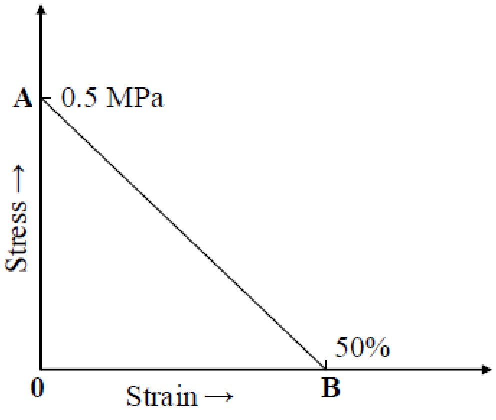
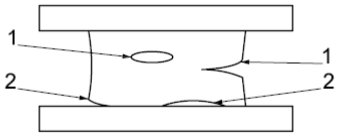


FIG. 5 STRESS-STRAIN TRIANGLE



Key:

1 Loss of cohesion
2 Loss of adhesion

FIG. 6 ILLUSTRATION OF THE EXTENSION OF LOSS OF ADHESION OR COHESION THROUGH THE WHOLE DEPTH

5.2.4.2 If a Roman scale (*see* **A-3.6.1**) is used, the value of tensile stress in the seal at rupture shall be at least 0.7 MPa.

6 REQUIREMENTS FOR COMPONENTS

The following tests are intended for factory production and process control. The manufacturer shall carry out these tests each day before the start of production in their premises. In case of butterfly test, butterfly adhesion test, snaptime test, peel adhesion test and delta T test for desiccant, these tests shall be carried out also after change of kit/drum. The manufacturer shall keep an adequate record of these tests.

6.1 Test for Two Part Sealant

It is very important that two part sealant be checked properly to ensure well curing. Improper mixing of silicone will result in adhesion failure and eventually lead to unit failure.

6.1.1 *Butterfly Test*

The sealant shall pass the butterfly test when tested as prescribed in Annex B.

6.1.2 *Butterfly Adhesion Test*

The sealant shall pass the butterfly adhesion test when tested as prescribed in Annex C.

6.1.3 *Peel Adhesion Test*

The sealant shall pass the peel adhesion test when tested as prescribed in Annex D.

6.1.4 *Snap Time Test*

The measured snap time shall be within 30 to 60 minutes, when tested as per Annex E.

6.1.5 *Shore A Hardness Test*

The measured Shore A hardness reading shall be between 30 and 50, when tested as per Annex F.

6.2 Test for Spacers

6.2.1 *Butyl Quantity Test*

The primary sealant quantity shall not be less than 2.7g per side per running meter, when tested as per the method prescribed in Annex G.

6.2.2 *Test for Aluminum Spacers*

Aluminium spacers shall pass the test for tightness of the welded slit as prescribed in Annex H.

6.3 Delta-T Test for Desiccant

When the desiccant is subjected to the test as prescribed in Annex J, the temperature rise of water shall not be less than 32°C.

7 PACKING AND MARKING

7.1 Packing

Insulating glazing units shall be packed as agreed to between the manufacturer and the purchaser.

The packet shall be marked with the following information:

a) Indication of the source of manufacture,
b) Nominal thickness of IGU,

c) Code or batch number,
d) Month and year of manufacture, and
e) Type of glass.

7.2 Marking

7.2.1 Each unit shall be marked with the words 'Insulating Glass'.

In each unit, the constituent pane shall be marked indelibly and distinctly with the following information:

a) Toughened safety glass, shall be marked with the word 'Toughened';
b) Heat strengthened glass, shall be marked with the words 'Heat Strengthened';
c) Laminated glass, shall be marked with the words 'Laminated Safety'; and
d) Indication of the source of manufacture.

7.2.2 *BIS Certification Marking*

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

8 SAMPLING

Representative samples of the material shall be drawn as prescribed in Annex K.

ANNEX A

(*Clause* 5.2.4)

EDGE STRENGTH TEST

A-1 GENERAL

The test consists of preparing a number of test specimens consisting of glass-sealant-glass joints, some of which are unaged and some are subjected to ageing processes (*see* **A-3.2** to **A-3.4**) before tensile load test.

A-2 TEST SPECIMEN

The components of the test specimen (*see* Fig. 7) shall be of the following dimensions:

Glass pane = 75 mm × 12 mm × 6 mm

Sealant = 50mm × 12mm × 12 mm

After the glass pane is cut to the desired dimensions, it should be thoroughly cleaned and dried before being used in the test specimen. The cleaning process may be similar to that used in the manufacture of IGU and with similar precautions as being followed for sealing and bonding of glass with sealant. Other cleaning processes are allowed provided that the process does not interfere with the adhesive quality of the sealant, for example, by chemically modifying the glass surface.

After cleaning the glass, the test specimen shall be prepared from freshly mixed (in case of two part sealant) or freshly unpacked sealant. The sealant shall be prepared according to the manufacturer's instructions. For two-part systems, the mix ratio shall be within the limit of ± 5 percent of the absolute value prescribed.

The glass panes of size 75 mm × 12 mm × 6 mm shall be so arranged as to form a cavity of 50 mm × 12 mm × 12 mm between two parallel surfaces. Larger glass panes may be used if this aids the production of the test samples, but the cavity shall still be of the size 50 mm × 12 mm × 12 mm. Gunnable seal shall be extruded smoothly into the cavity and allowed to set without any disturbance to form a bond of desired dimensions (*see* Fig. 7). Polyethylene or other non-adhesive mould pieces may be used to ensure the correct joint dimensions. At least one 50 mm × 12 mm surface of the sealant shall be exposed to the atmosphere during initial curing. For pre-extruded sealants, a length of 50 mm shall be applied on one piece of glass. The second piece of glass is compressed onto the sealant according to the sealant manufacturer's instructions. Sealant height should be preferably 12 mm.

Condition all prepared test specimen at standard room conditions for not less than 21 days (initial cure).

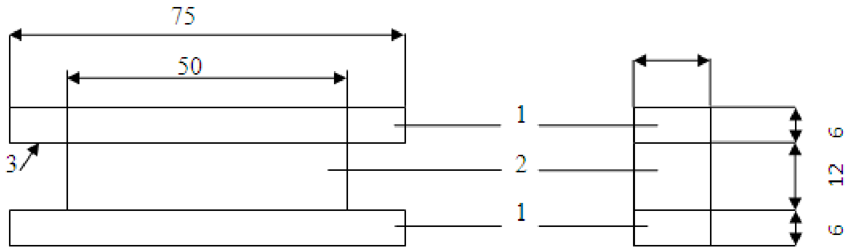
A-3 PROCEDURE

A-3.1 Initial Cure

After initial cure, further condition seven test specimens at standard room conditions for at least seven days.

A-3.2 Heat Exposure

After initial cure and further conditioning at standard room conditions for at least seven days, another seven test specimens shall be aged in a closed oven at 60 ± 2°C for 168 ± 5h. Where the sealant shows plastic flow at 60°C, the spacers shall be retained between the two glass pieces to prevent bond deformation.



Key	
1	Glass
2	Sealant
3	Face that may be coated

FIG. 7 TEST SPECIMEN

A-3.3 Water Immersion

After initial cure and further conditioning at standard room conditions for at least seven days, another seven test specimens shall be immersed in 1 l to 2 l of distilled or deionized water for 168 ± 5h, at standard room condition. Fresh water shall be used for each test. The conductance of the fresh water shall be equal to or less than 30 µS.

A-3.4 UV Exposure

After initial cure and further conditioning at standard room conditions for at least seven days, another seven test specimens shall be subjected to UV irradiation for 96 ± 4h, which shall be perpendicular to the glass and with an intensity of 40 ± 5W/m^2 in the UV-A range.

The height of the UV source shall be adjusted to ensure all joint assemblies are exposed to the minimum irradiation intensity. The irradiation intensity shall be measured at the beginning and end of each test. The UV source shall be replaced with a new one when it can no longer sustain the minimum irradiation intensity.

A-3.5 After initial curing, ageing (where relevant) and conditioning for 24 h to 48 h at standard room conditions, width, depth and height of the test specimens shall be measured accurately. The test specimens shall then be subjected to tensile load (*see* **A-3.6**) by means of an extensiometer (with accuracy equal to or better than 2 percent) or a Roman scale.

A-3.6 Application of Tensile Load

A Roman scale (*see* Fig. 9) or an extensiometer may be used for the test.

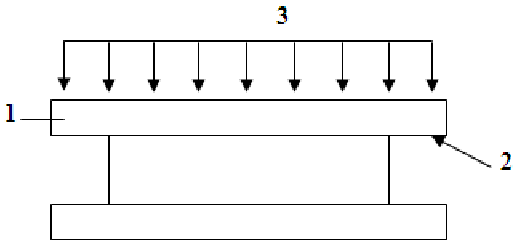
A-3.6.1 *Application of Tensile Load Using Roman Scale*

The effective weight applied to the sealant joint is equal to the product of actual weight (W) on the Roman scale plate and the ratio of b/a (*see* Fig. 9). The test specimen shall be clamped with a parallel sample holder.

The load shall be applied for a maximum of 10 s with no adhesive or cohesive failure of the sample. If no rupture occurs, increase the load by adding increments of 0.5 kg to the scale until the sample ruptures. Record the load at which rupture observed and calculate the tensile load.

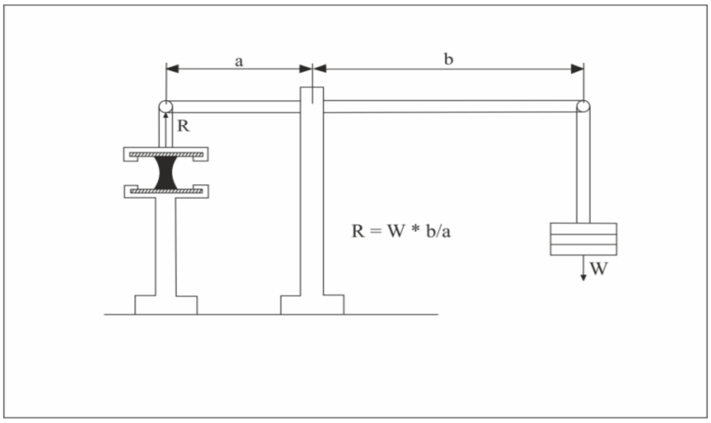
$$\text{Tensile load} = \frac{W \times {}^{b}\!/_{a}}{50 \times 12} \text{ MPa}$$

NOTE — Actual weight (W) = Actual mass of load in the Roman scale in kg × 9.81



Key	
1	Clear glass
2	Tested surface which can be coated
3	Ultraviolet radiation

FIG. 8 ORIENTATION OF THE SURFACE BEING TESTED TO THE ULTRAVIOLET RADIATION



Key	
1	Holder with test specimen
2	Weight

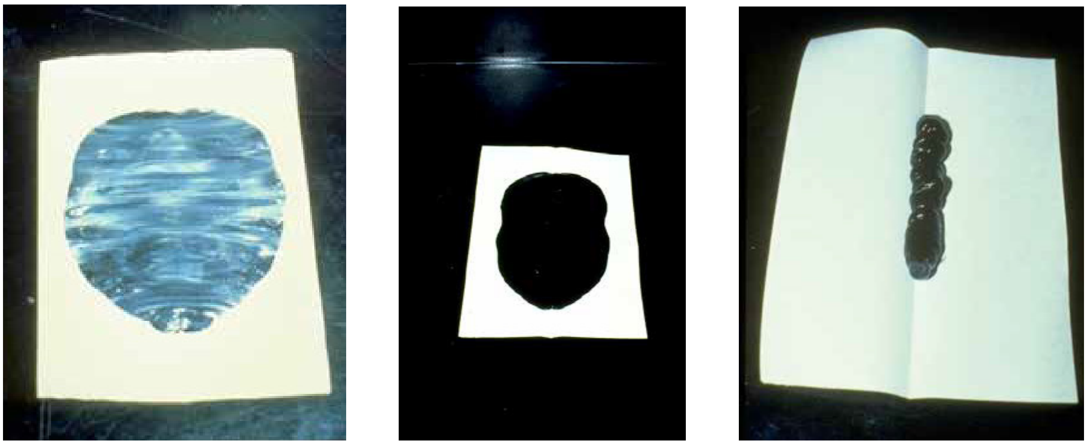
FIG. 9 ROMAN SCALE

ANNEX B

(*Clause* 6.1.1)

BUTTERFLY TEST

The purpose of butterfly test is to check for adequate mixing of the base with catalyst components. The test is performed by dispensing a bead of sealant on a piece of white paper and folding the paper in half, smearing down the sealant bead as shown in Fig.10. Then the paper shall be reopened and inspected visually. The smeared sealant should appear uniform in colour with no white streaks.



(a) (b) (c)

Key	
(a)	Sealant bead on paper
(b)	Homogenous mixing
(c)	Non homogenous mixing

Fig. 10 Illustrative Example Of Butterfly Test

ANNEX C

(*Clause* 6.1.2)

BUTTERFLY ADHESION TEST

C-1 GENERAL

The purpose of this test is to evaluate the adhesion of sealant to glass and spacers. Improper mixing ratio and poor raw material quality of sealant can result in improper adhesion of sealant to glass and spacers and ultimately cause unit failure.

C-2 PROCEDURE

Two glass panes of size approximately 200 mm × 200 mm or equivalent shall be used to make the test specimen. Two edges (opposite to each other) shall be sealed using spacer and sealant. Allow the sealant to cure completely for 24h. A longitudinal cut shall be made on the centre line on the surface of the specimen, parallel to the sealed edges. Break the glass pane along the cut and bend the two halves outward at a 180° angle (*see* Fig. 11). Inspect the adhesion of the secondary seal.

C-3 OBSERVATIONS

Sealant shall not be detached from glass and spacer. The test sample shall also be examined for complete filling of sealant as well as presence of voids and bubbles in the sealant. The continuity of the primary sealant application shall also be noted.

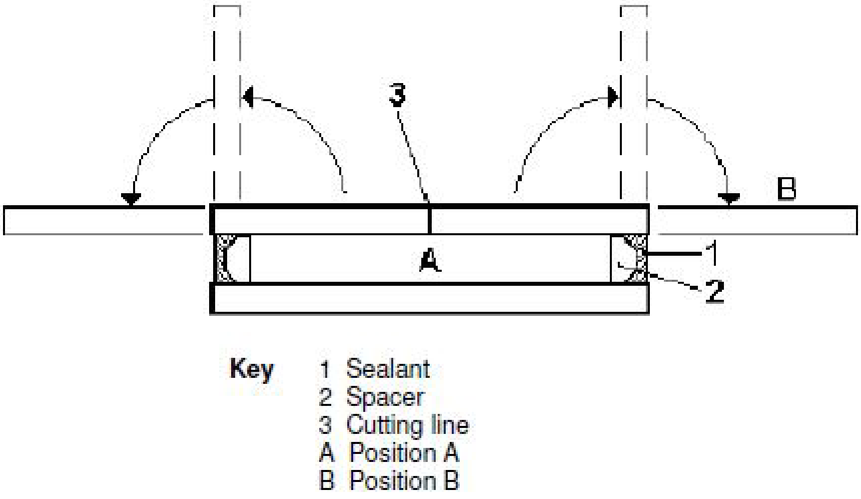


FIG. 11 BUTTERFLY ADHESION TEST

ANNEX D

(*Clause* 6.1.3)

PEEL ADHESION TEST

D-1 GENERAL

The purpose of this test is to verify adhesion of sealant to the glass substrate. An adhesive or cohesive failure of sealant with glass substrate can result due to improper curing of sealant or poor quality of raw material.

D-2 PROCEDURE

Clean the substrate thoroughly to remove greasy/oily matter and dust, and dry. Place a piece of bond breaker tape across the flat surface. Apply a bead of sealant and spread it to form a strip approximately 200 mm × 15 mm × 6 mm. At least 4 cm of the sealant should be applied over the bond breaker tape (*see* Fig.12).

The sealant shall be cured at room temperature for at least 24 h. Grab the 4 cm long tab of sealant which overlays the bond breaker tape and pull it at a 180° angle (*see* Fig. 13). Peel back only 1 to 2cm of sealant leaving the remainder in place for additional testing.

D-3 RESULT

The sealant shall be considered acceptable if 100 percent cohesive failure occurs, since this indicates that the strength of adhesion is greater than the strength of cohesion. The sealant shall be deemed to be unfit for application if adhesive failure occurs.

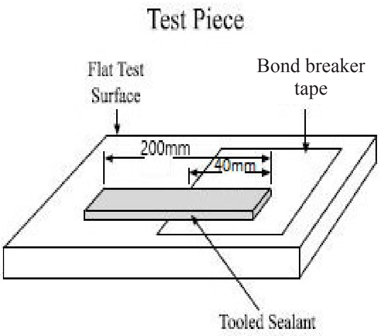


FIG. 12 PEEL ADHESION TEST SPECIMEN

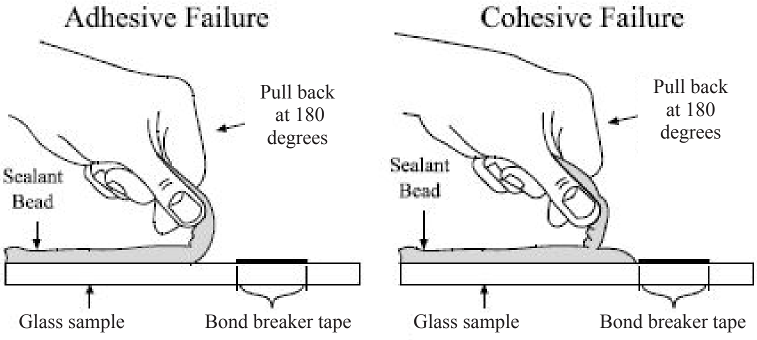


FIG. 13 ADHESIVE AND COHESIVE FAILURE OF SEALANT

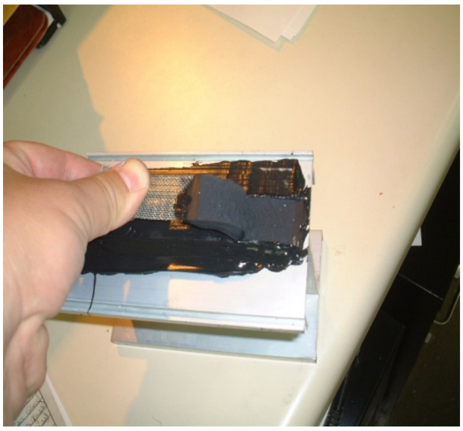


FIG. 14 ILLUSTRATIVE EXAMPLE OF COHESIVE FAILURE

ANNEX E

(*Clause* 6.1.4)

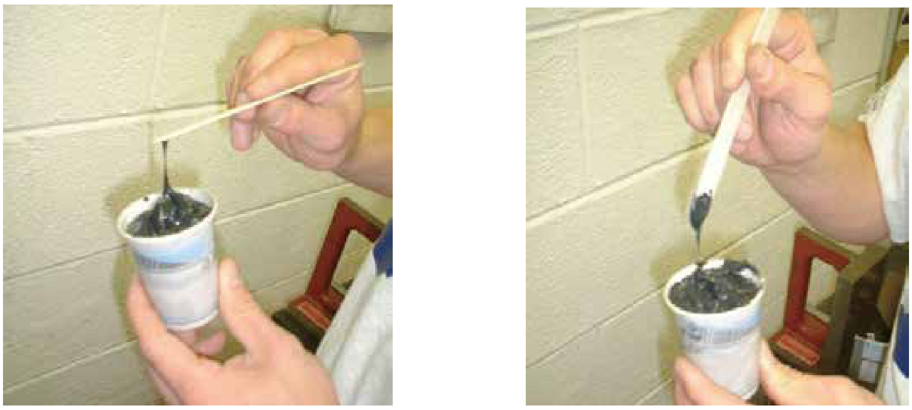
SNAP TIME TEST

E-1 GENERAL

The purpose of this test is to demonstrate the proper mix ratio and the proper curing of sealant. Mixed sealant will behave like a one-component sealant until the chemical reaction between the base material and curing agent begins to occur, which causes the sealant to begin to “snap” and show elastomeric or rubber properties.

E-2 PROCEDURE

Fill a small container with mixed sealant. Place a small stick or spatula into the sealant. At constant intervals of time, pull the stick/spatula out without stirring or agitating the sealant. As the curing progresses, the sealant becomes viscous. Time taken for the sealant to tear cohesively and snap back when pulled shall be recorded as ‘snap time’.



(a)Initial (string)

(b) Snap

FIG. 15 SNAP TIME TEST

ANNEX F

(*Clause* 6.1.5)

SHORE-A HARDNESS TEST

The IGU sample shall be cured for a period of 24 h at standard room conditions. Then, the hardness of the cured sealant shall be checked using a Shore-A hardness meter.

ANNEX G

(*Clause* 6.2.1)

BUTYL QUANTITY TEST

G-1 GENERAL

This test is used to estimate the minimum quantity of primary sealant applied on a spacer. Primary sealant needs to be applied on spacers in a certain minimum quantity for effective glass to spacer primary seal.

G-2 PROCEDURE

A spacer specimen shall be drawn randomly from production line and primary sealant shall be extruded under standard production conditions. The primary sealant shall be carefully removed from the spacer and the mass of primary sealant shall be estimated.The length of the spacer shall also be measured. Calculate the mass of primary sealant per running meter (mass of primary sealant divided by length of spacer).

ANNEX H

(*Clause* 6.2.2)

TEST FOR ALUMINIUM SPACERS

H-1 GENERAL

This test is applicable to hollow spacers with profile having a closing slit on the back. In order to have a stiff and tight spacer, the closing slit is welded. This test checks the tightness of the welded slit.

H-2 PROCEDURE

Take approximately 1 m of spacer bar. Place the test piece in a horizontal, slightly sloping position, with the welded slit downwards. Spray a penetrating liquid (fluorescent dye) inside the spacer until the liquid comes out from the opposite end. Wait for 5 min.

Check with UV light for leakage of liquid along the welded slit. Tightness of the welded slit is considered acceptable in case of no leakage.

NOTE — In case leakage is observed, the profile of closing slit shall be reviewed and modified so as to ensure proper tightness of welded slit.

ANNEX J

(*Clause* 6.3)

DELTA –T TEST FOR DESICCANT

J-1 GENERAL

This test is used to check the adsorption capacity of desiccants used in insulating glass units.

J-2 PROCEDURE

Take water at room temperature in a beaker and measure its initial temperature (T_i) and quantity in ml. Add equal quantity of desiccant in g. Now the temperature of water will start rising due to exothermic reaction. Measure the temperature of water at equal intervals and note the maximum temperature (T_f). Calculate $\Delta T = T_f - T_i$.

ANNEX K

(*Clause* 8)

SAMPLING OF INSULATING GLAZING UNIT

K-1 All the Insulating Glazing Units (IGU) of the same combination of glasses and system, which are processed under similar conditions in a day shall be grouped together and shall constitute a lot. Sample shall be made and tested from each lot to determine its conformity to the requirements of this specification. In order to ensure the randomness of selection, procedure in IS 4905 shall be followed.

K-2 The sampling plan as described in Table 3 may be followed for the various tests to be performed as per the requirements of this specification.

Butterfly test, butterfly adhesion test, peel adhesion test, snap time test, shore A hardness test, butyl quantity test, test for aluminium spacers and delta T test for desiccant are tests on components of IGU. These tests are intended for in house production and process control. The manufacturer shall keep an adequate record of these tests being carried out.

Table 3 Sampling of Insulating Glazing Unit

(*Clause* K-2)

Sl No.	Testing Parameters	No. of Samples	Size of Samples/Criteria	Acceptance Criteria
(1)	(2)	(3)	(4)	(5)
1	Dimensions and squareness	5 percent of the quantity from each typical combination, but not less than five glasses.	Actual size of product	All samples shall pass. In case of any single failure, draw another 5 percent and repeat the tests. None of these samples shall fail.
2	Thickness tolerance along periphery of IGU			
3	Displacement /Mismatch			
4	Sealant protrusion			
5	Bite size			
6	Dew point measurement	6	Actual size of product	All samples shall pass. In case of any single failure, draw another 6 samples and repeat the tests. None of these 6 samples shall fail.

Table 3 *(Concluded)*

Sl No.	Testing Parameters	No. of Samples	Size of Samples/Criteria	Acceptance Criteria
(1)	(2)	(3)	(4)	(5)
7	Climate test (optional)	12	305 mm × 502 mm	All samples shall pass. In case of any single failure, draw another 12 samples and repeat the tests. None of these 12 samples shall fail.
8	Inert gas level test (optional)	10	350 mm × 500 mm	All samples shall pass. In case of any single failure, draw another 10 samples and repeat the tests. None of these 10 samples shall fail.
9	Edge strength(type test)	28	75 mm × 12 mm × 6mm	All samples shall pass. In case of any single failure, draw another 28 samples and repeat the tests. None of these 28 samples shall fail.

ANNEX L

(*Informative*)

OTHER PHYSICAL CHARACTERISTICS

L-1 INTERFERENCE COLORATION

L-1.1 Brewster’s Fringes

When the glass pane surfaces exhibit near perfect parallelism and the surface quality is high, the insulating glazing unit shows interference coloration. These are lines varying in colour as a result of diffraction of light, creating an interference pattern. When the sun is the light source, the colours vary from red to blue. This phenomenon is inherent to the insulating glazing unit construction.

L-1.2 Newton Rings

This optical effect only occurs in faulty insulating glazing units when the two panes of glass are touching or nearly touching in the centre of the IGU. The optical effect is a series of concentric coloured rings with the centre being in the point of contact/near contact of the two panes. The rings are roughly circular or elliptical.

L-2 GLASS DEFLECTION DUE TO VARIATIONS IN TEMPERATURE AND BAROMETRIC PRESSURE

Temperature variations of the space filled with air and/or gas and barometric pressure variations of the atmosphere and altitude will contract or expand the air and/or gas in the cavity and consequently deflections of the glass pane will occur, resulting in distortion of reflected images. These deflections, which cannot be prevented, show variations over time. The magnitude depends partially on the stiffness and size of the glass panes, as well as on the width of the cavity. Small sizes, thick glasses, and/or small cavities reduce these deflections significantly.

L-3 EXTERNAL CONDENSATION

External condensation on insulating glazing unitmay occur on either side of the IGU. When it is inside the building, it is principally due to high humidity in the room, together with a low outside temperature. Kitchens, bathrooms, and other high humidity areas are particularly susceptible to this type of external condensation. When it is outside the building, condensation is principally due to nocturnal heat loss of the outside glass surface by infrared radiation to a clear sky, together with high humidity, but no rain. These phenomena are due to atmospheric conditions and do not constitute failures of the insulating glass.

L-4 NATURAL COLOUR OF CLEAR GLASS

Generally, clear glass has a very light green appearance, especially at the edges. It becomes more visible when the glass is thicker or multiple layers of clear glass are used.

L-5 COMPATIBILITY OF INSTALLATION SEALANTS WITH IGU SEALANT

It is important to identify and use installation sealants which are compatible with the two–part secondary sealant used in sealing insulating glazing units. Use of general purpose sealants with high acetic curing properties can seriously dent the performance of the secondary sealant and cause flaking.

The secondary sealant should be compatible with the structural sealant and respective sealant manufacturers may be consulted for selection of compatible sealants. Acetoxy silicone sealants should not be used as secondary sealants. Under certain conditions, the corrosive vapours liberating from acetoxy cure silicone sealant can cause degradation of two part silicone secondary sealants, potentially leading to premature failure of the insulating glazing unit.

L-6 SEALANT COMPATIBILITY

It is advisable to confirm the compatibility of the sealants toother accessory materials (setting- blocks, gaskets, spacers, weather-seals etc.) as follows. The sealant is applied in direct contact with the accessory material in question. The test specimen is placed in a chamber with high-intensity ultraviolet radiation. After the test period, samples are inspected for compatibility in the form of sealant discolouration and adhesion. It may be noted that non-silicone setting and edge blocks have the ability to cause discolouration of secondary sealants and field-applied silicone weather-seals.

L-7 EXPOSURE TO SOLVENTS

Silicone insulating glass sealants are susceptible to swelling when in contact with solvents, such as isopropanol, volatile siloxane fluids, methylethylketone, and terpenes. These solvents will not decompose the silicone, but will permeate the silicone and attack the polyisobutylene primary sealant. Solvent-based water repellents that are post-applied to a masonry building and allowed to enter the glazing weep system have been documented to cause polyisobutylene flow within a sealed insulating glazing unit. Setting blocks and edge blocks that are saturated with solvent have been documented to cause polyisobutylene flow within a unit. Solvent-extended sealants and solvent-based sealants contacting the secondary seals of an IGU can have similar effects. Polyisobutylene flow within a unit can be very unsightly and may result in premature fogging.

ANNEX M

(*Informative*)

FOGGING

Exposure to high temperature and/or solar irradiation may volatilize components of an IGU. When these volatiles condense on the inside surfaces of an IGU, it results in chemical fogging. Chemical fogging can appear similar to condensation in the airspaces. ISO 20492-2 prescribes two methods for testing the resistance to chemical fogging of pre-assembled, permanently sealed IGUs or IGUs with capillary tubes intentionally left open.

ANNEX N

(*Foreword*)

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